POLLUTION SURVEY:
OLDMAN RIVER
BOW RIVER
RED DEER RIVER
NORTH SASKATCHEWAN RIVER
1969-1970

POLLUTION REPORT NO.1

Alberta Fish and Wildlife Division

FISHERIES SECTION

SUMMARY REPORT

BIOLOGICAL POLLUTION SURVEYS

OLDMAN RIVER

BOW RIVER

RED DEER RIVER

NORTH SASKATCHEWAN RIVER

1969 - 1970

ALBERTA FISH AND WILDLIFE DIVISION
GOVERNMENT OF THE PROVINCE OF ALBERTA
DEPARTMENT OF LANDS AND FORESTS

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES

INTRODUCTION

In recent years stream pollution investigations have been receiving increasing attention. With modern industrial expansion and increasing urbanization the need for greater conservation of our aquatic resources has become more obvious, due to shortages of water in some areas and destruction of the value of other streams by increasing pollutional loads. This need is being met with varying degrees of success by our federal and provincial agencies, and by an increasing awareness of their own responsibilities by public officials and by industry. In spite of greater activity with regard to the chemical and physical aspects of pollution investigation, biological data do not at the present time constitute a standard part of this work in many parts of the country including Alberta. This would seem to be an odd state of affairs when one considers that, apart from public health, man's primary interest in pollution or in any other alteration to a natural water is in its effects on general amenities and fishing or on the subsequent use of the water for other purposes. These are primarily biological in character, and even if the water is to be used for cooling purposes only, its capacity to grow sewage fungus is of much greater importance than its B. O. D. The reasons for this neglect of biotic data are not hard to find. Since the public is presently actively engaged in becoming more informed on pollution matters, it appears to be appropriate at this time to remove ourselves from professional isolationisms and attempt to outline some of the historical reasons and internal arguments which have caused this neglect. These reasons and arguments are, however, presented with a great deal of trepidation. It is always risky to attempt to explain a discipline in a few words. One invariably tends to oversimplify, therefore leaving the reader with the

erroneous impression that the matter under discussion is simple and could be understood in its entirety with the aid of one or two short courses. This impression is especially left when discussing the field of biology, since every human through his daily associations with living matter considers himself a self-made expert in that field.

In a less complex society than the present, the matter of water pollution invariably became a community issue only when it became a health hazard--only when water made people sick did it become a matter of serious public concern--only when their lives or health were endangered were people ready to demand and support government action to abate pollution. Such government action usually involved the local Board of Health. Thus, the traditional pattern was established whereby water pollution was viewed as merely a local health problem, one that would and should be handled locally by doctors. This concern of pollution as a health hazard coincided with the rise of chemistry as a science. Therefore, the early work on pollution was primarily chemical. Chemical methods became firmly established and biological investigation was thought to have little to offer. This impression was sometimes reinforced during the first few decades of this century by the biologists themselves. In their attempt to explain their methods to the laymen they tended to oversimplify or too excessively complicate their explanations.

> "This was a particularly unfortunate thing to do during the first few decades of this century when many members of the general public, and indeed many scientists, were disinclined to take biology seriously. To them the biologist seemed to be a slightly ridiculous figure with a butterfly net, and when they found that his analytical methods were incomprehensible to them they, somewhat naturally, turned again to the familiar and apparently more precise methods of the chemist." Hynes, 1963

> "The idea, seems, also, to have arisen that biological phenomena are difficult to investigate and that their interpretation requires a highly skilled specialist. The implications of this would appear to be that chemical data are easier to assess, and that chemists involved in this type of work need not be particularly skilled." Hynes, 1963

Interpretation of chemical data is every bit as difficult as is that of biological data. It is, however, perhaps worth stressing that it takes a trained chemist to interpret chemical analyses. No book or short course of study can turn an untrained man into a freshwater biologist any more than it can turn him into a water chemist; both must acquire their essential background knowledge by training and experience. The following main arguments for chemical and/or biological methods arose from this development.

Several disadvantages arise if one uses the chemical method solely for water pollution control and abatement. Chemical analysis is at best an indirect measure of the basic biological properties of the water. To know the oxygen content, B. O. D., and other measurable chemical or physical properties of an effluent, can only allow one to guess at the effect it is likely to have on the living things in a river, stream, or lake; only direct biological study can actually determine what these will be. The chemist is in a position similar to that of the six blindman in the old Hindu fable. In this fable each man attempts to describe an elephant from his own vantage point; one feels a leg, and therefore emphatically states that the elephant is like a tree; another the tail, and so like a rope; another the side, and so like a wall; etc. To repeat, chemical analysis is at best an indirect measure of the basic biological properties of the water.

The second disadvantage is that a chemist has to make a long series of observations in order to obtain an average value, and even then his samples

may all happen to be collected at times other than those of extreme conditions. Average values mean little in attempting to interpret the effect of pollutants on living matter. When an animal or plant is dead it is dead. It is futile to attempt to tell a man who has died in a London smog that, on the average, the air in London is not harmful to man. The extreme conditions are the important conditions. This disadvantage is starting to be alleviated in the use of constant monitoring equipment which measure certain of these important chemical parameters.

Biological analysis also has its disadvantages. The greatest disadvantage is that it does not deal directly with concentrations. The sewage works manager and the industrialist need figures to which they can work; they must have some sort of measure by which they can test the quality of their effluents and so check the efficiency of their purification plants. This is most readily supplied by chemical analysis and they therefore turn to the chemists for information about permissible concentrations. A second disadvantage is that it does not indicate precisely which chemical could be responsible for a pollution condition. In the absence of actively observing a fish-kill, biological methods can reveal only differences between organic and poisonous pollutions.

Biological study of a river, stream, or lake, however, has several advantages. Enumerated, these are:

1) A single series of samples reveals the actual state of the animal and plant communities. These communities themselves represent the results of a summation of the prevailing conditions. The animals and plants provide a more or less static record of the prevailing conditions.

2) Biological investigation reveals the effects of intermittent pollution or the result of a single discharge of a poisonous substance which the chemist may miss altogether.

3) Biological investigation enables the investigator to pin-point the source of pollution. To do this the biologist has merely to move upstream until he reaches the place where biological effects begin. This was dramatically illustrated in the last year when biologists pin-pointed the source of the fish-kill in the river Rhine in Germany.

Therefore, from the brief arguments presented, one can see that pollution studies should never be confined only to the use of chemical or biological methods. The two disciplines complement each other and are both required to present an accurate appraisal of the aquatic situation.

Today most stream pollution investigations are carried out or directed by engineers. While many of these engineers desire, or at least approve of, the use of biotic data the ideas that such biological investigations are exceedingly complicated and prohibitively expensive are wide spread.

Since this is the first annual biological pollution report, we have tended to oversimplify. Even though biological pollution surveys have been conducted since 1908 and 1909 (Kolkwitz and Marsson) we may still have skeptics among our readers. The original complicated analysis of the material, complete with scientific names of organisms and statistical analysis, will soon be available in reputable scientific journals for the

benefit of those readers.

METHOD

Sampling sites were carefully selected for location and bottom type. We attempted to obtain samples for biological study at the same locations as samples obtained for chemical study by the Department of Public Health. This was not always possible since our sites had to be strictly comparable in habitat. One cannot expect to sample a mud flat and a rocky area, and expect to find the same animals in each. Riffle sections only were sampled. Samples were obtained from the rivers in the fall (August and September) and in the spring (April and May) of 1969 and 1970, respectively. Both sets of samples were taken at low water time. The fall ones just before freeze-up and the spring during the low water period immediately after ice breakup. Additional samples were obtained from the Bow River in the spring of 1969. A fine mesh dip net was utilized for sampling. Ten two-minute random samples were obtained at each sample site. Using this method, a large area of the river at each site was sampled.

DISCUSSION OF METHOD

Due to the unwarranted confidence provided by simple chemical tests such as the dissolved oxygen and B. O. D. tests, pollution control authorities have looked to biologists for an equally simple test. This has often come in the form of a request for an "indicator species" or a "biological thermometer". The urgency of their requests can be directly related to the time that has elapsed since they have attended a one- or two-week short course usually entitled "The Use of Biological Indicators in Pollution Abatement." At this time the authority, in his infinite wisdom, will select his favorite animal or plant depending on the bias of the instructor

or the state of the pupil's hangover. It is then difficult to convince this authority that a magical indicator species does not exist. This, however, is not solely the fault of the authority. Biologists themselves have often been guilty of this. If I may quote Hynes (1963) again,

> "There has been some dispute among biologists as to which type of organism is most indicative of pollution. This seems to me to be a very fruitless discussion. Obviously fishes are the least satisfactory because they are difficult to see or catch, and are less abundant than smaller creatures. They are also very mobile, so they often occur far away from their normal habitat. Bacteria, algae, rooted plants and invertebrates on the other hand are less mobile, more abundant and easier to collect, so they clearly offer greater possibilities; but whether one group or another of these is the most suitable subject for investigation depends on the circumstances. Ideally all should be studied, as all react to the various kinds of pollution."

> "In conclusion, therefore, it seems fair to say that all categories of living creatures are useful in the study of pollution, and that the investigator should use all the methods which are feasible for him under the prevailing conditions. For severe organic pollution, given that he has suitable laboratory facilities near at hand, ciliates and other micro-organisms are useful; for less severe cases or pollution of other types the larger invertebrates and the algae, both of which can be preserved and studied later at leisure, are useful. For mild pollution he can, in our present state of knowledge, use only the larger invertebrates. For all investigations numerical data and the study of the whole community are important:".

Since this initial study attempted to provide base-line information regarding the presence of pollution, the severity of pollution and the types of pollution in Alberta's rivers we chose to use the larger invertebrates. The choice of the invertebrates also supplied us with additional information since these animals are the main source of food for the fish found in our rivers.

In the rivers studied, the majority of these consisted of the young of four insect groups, the nymphs of mayflies and stoneflies, the caddis

fly larvae and the midge larvae (blood worms); and one worm group (sludge worm) (Figure 1). These animals are not very mobile and so must spend their lives within the immediate areas in which they are born or hatched. Therefore, they do not have the choice of migrating away from undesirable conditions, and so must suffer whatever is presented to them.

The mayflies, stoneflies, and caddis flies are generally large gill-breathing aquatic insects. They, like fish, need a healthy supply of oxygen for survival. Therefore, they are found mainly in clean waters. The midge larvae and sludge worms usually have more than one method of respiration and so can survive under certain pollution conditions. It should be mentioned, however, that a healthy supply of oxygen is not the only prerequisite for a healthy river. Other factors which may destroy the animal or plant life in a stream are described in Appendix B. As a result, considered as an ecological community, these five groups provide a good indication of the conditions of a water body.

An explanation regarding the timing of the samples may be in order. Of the animals mentioned the majority emerge as adults during the summer months (Figure 1). These may then live for as little as a day, mate, and lay their eggs. These eggs hatch and the nymphs or larvae then grow at a rapid rate during the fall and continue to grow at a slow rate during the winter months. These then in turn emerge as adults during the summer to repeat the cycle. Therefore, a comparison of the samples taken during the fall with those taken in the spring reveals the conditions during the critical winter pollution period.

RESULTS

Certain terms will be used in the presentation of the results. These

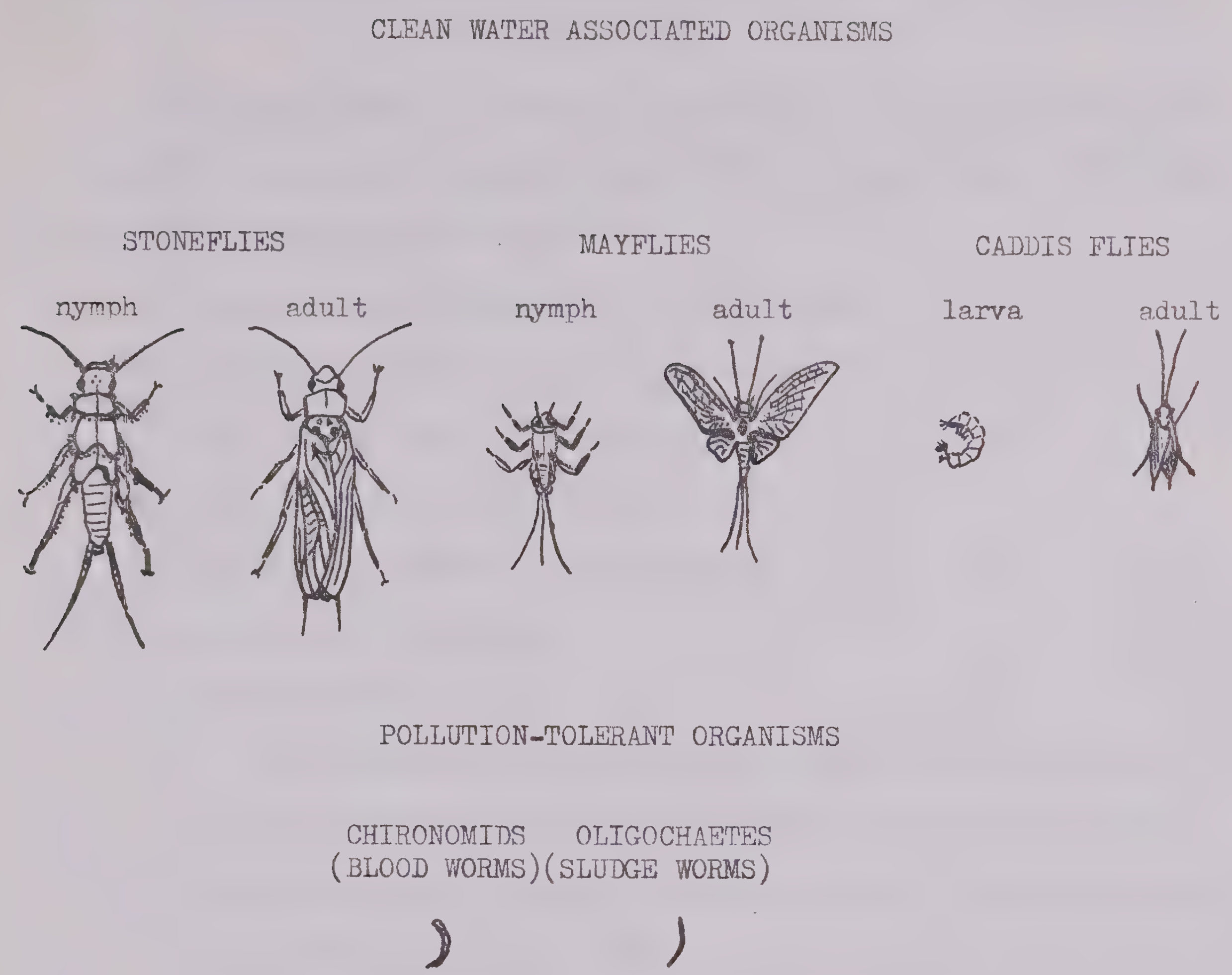


Figure 1. Examples of Organisms Studied.

These organisms comprise the main source of food for our fish. In general terms, if one finds a predominance of clean water associated organisms, one could expect a predominance of game fish, e. g. trout, pike. If one finds a predominance of pollution-tolerant organisms, one could expect a predominance of rough fish, e. g. suckers.

terms will be defined in the Discussion of the Results section.

OLDMAN RIVER

This report presents a summary of biological results obtained from the Oldman River during the period August 1969 to April 1970. The following locations were sampled (Figure 2):

1) upstream from Lethbridge - 1 river mile;
2) downstream from Lethbridge - 5 river miles;
3) Coaldale bridge - 28 river miles;
4) Taber bridge - 52 river miles;
5) Highway #36 bridge - 66 river miles.

SITE #1, upstream from Lethbridge.

a) fall samples.

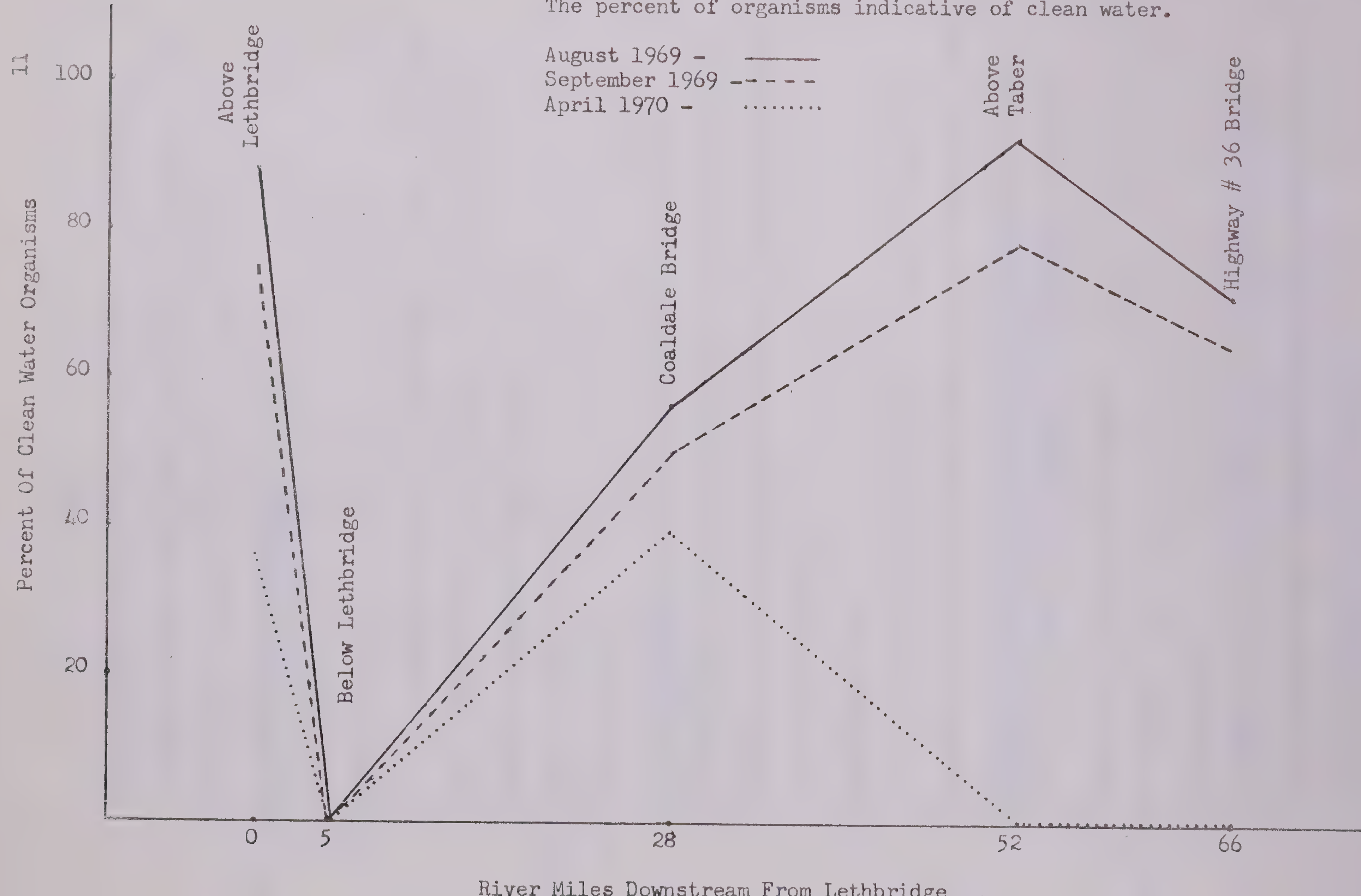
The samples taken at this time present a picture of the mature ecosystem. A variety of animals were found with clean water organisms (mayflies, stoneflies, caddis flies) comprising around 80% of the total number of animals found (Figure 2). The fall sample contained approximately 4000 animals.

b) spring samples.

The percent of clean water animals has been reduced from approximately 80% to approximately 40% of the total number of animals. A look at the upstream sites of the other rivers studied will reveal that some reduction in the percent of clean water organisms is a common winter occurrence. However, a reduction of the magnitude experienced on the Oldman River requires some explanation. The explanation is found in the extremely low flow rates of the Oldman River during this period

Figure 2. Oldman River Biological Pollution Survey

The percent of organisms indicative of clean water.



(see the Department of Public Health report). The drastic reduction in flow rates removed the available habitat with the clean water organisms naturally suffering the most.

SITE #2, downstream from Lethbridge.

a) fall samples.

b) spring samples.

The results from this site are simple to report. No clean water animals (Figure 2); less than a total of fifty animals found at any sampling time (Figure 3).

SITE #3, Coaldale bridge.

a) fall samples.

Approximately 55% of the animals found were animals generally associated with clean water. This represents a 25% degradation in the aquatic environment of a 55% recovery depending on your viewpoint.

b) spring samples.

Little significant alteration of the animal composition compared with the fall samples has occurred at this site. During 1969-1970, the river was apparently ice-free up to this point. This is reflected in the dissolved oxygen results (see the Department of Public Health report).

SITE #4, Taber bridge.

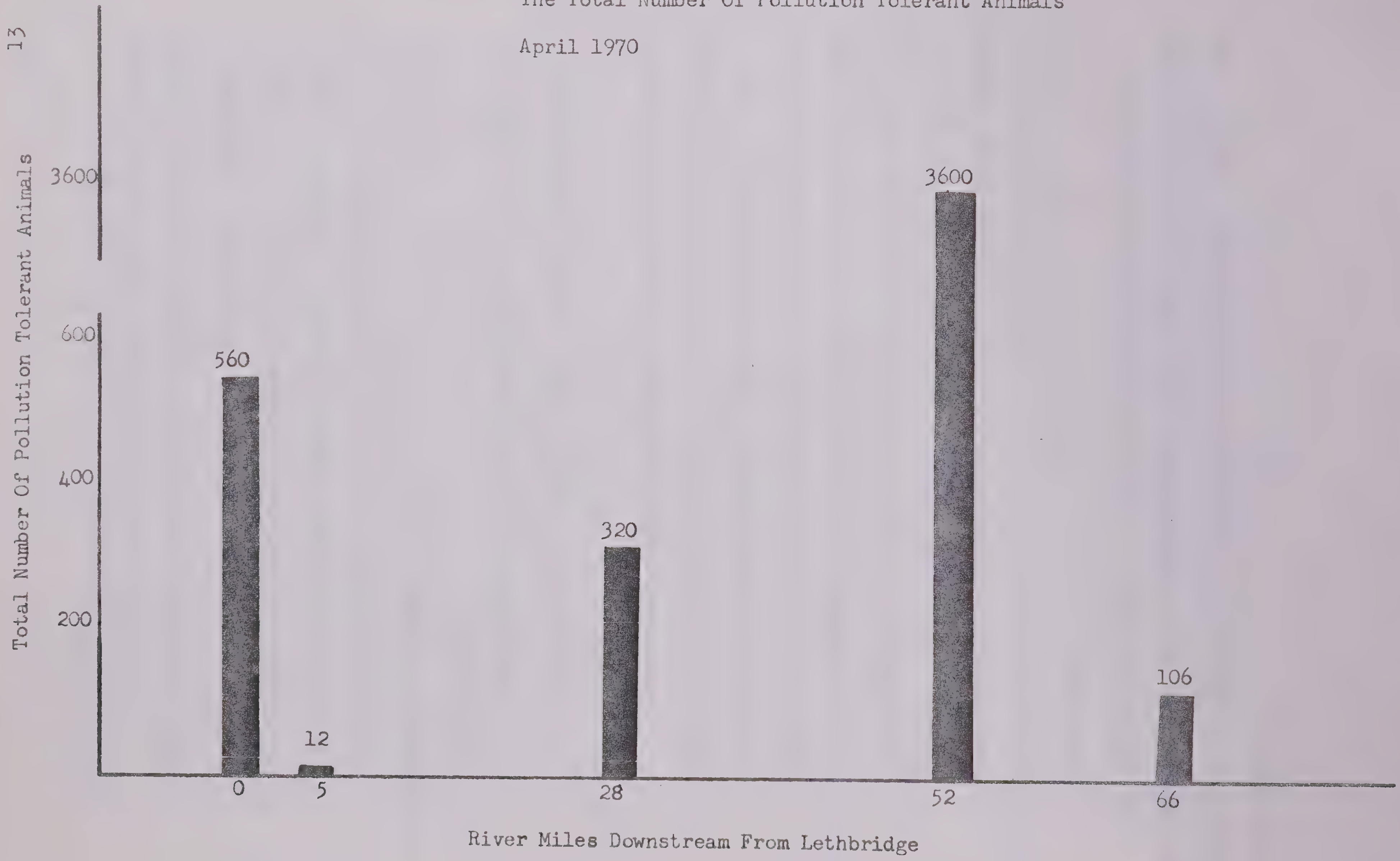
a) fall samples.

The river has recovered at this site reflecting again a mature ecosystem with approximately 80% of the animals being of the clean water-loving type (Figure 2).

Figure 3. Oldman River Biological Pollution Survey

The Total Number Of Pollution Tolerant Animals

April 1970



b) spring samples.

The drastic oxygen reduction that occurred on the Oldman River during this winter (see the Department of Public Health report) is obviously reflected in these results. The clean water organisms have been eliminated (Figure 2). The midge larvae and sludge worms were not, however, eliminated and a population explosion occurred at this site (Figure 3).

SITE #5, Highway #36 bridge.

a) fall samples.

A 10% reduction in clean water animals can be attributed to a deterioration of habitat resulting from decaying matter.

b) spring samples.

Clean water animals have been eliminated. Total numbers of even the remaining animals, the pollution-tolerant organisms, has drastically been reduced at this site (Figure 3). The reduction in clean water animals can be attributed to a continuation of the conditions found at Site #4 with additional oxygen demanding material being introduced during the sugar beet campaign. The introduction of solid material during this campaign also contributes to the loss of habitat which resulted in the extreme reduction in total numbers of animals found at this site.

The fishery potential of this river together with the destruction forces responsible for the deterioration of the river have been adequately presented to the Oldman River Sub-committee meeting October 9 and 10, 1968 (see Appendix A).

BOW RIVER

This report presents the summary of biological results obtained during the period August 1969 to May 1970. The following locations were sampled (Figure 4):

1) two locations above Calgary - Cushing Bridge and Cochrane;
2) Steirs Ranch - 15 river miles downstream from Calgary;
3) Carseland Bridge - 40 river miles downstream from Calgary;
4) Cluny Bridge - 78 river miles downstream from Calgary.

SITE #1, Cushing Bridge and Cochrane.

This site reflects a mature ecosystem. A variety of animals were found with clean water organisms (mayflies, stone-flies, caddis flies) comprising around 80% of the total number of animals (Figure 4).

SITE #2, Steirs Ranch.

Clean water organisms have been reduced to less than 10% of the total animals found.

SITE #3, Carseland Bridge.

Twenty to 30% of the animals counted were clean water animals. A reduction of approximately 50% from the mature eco-system site.

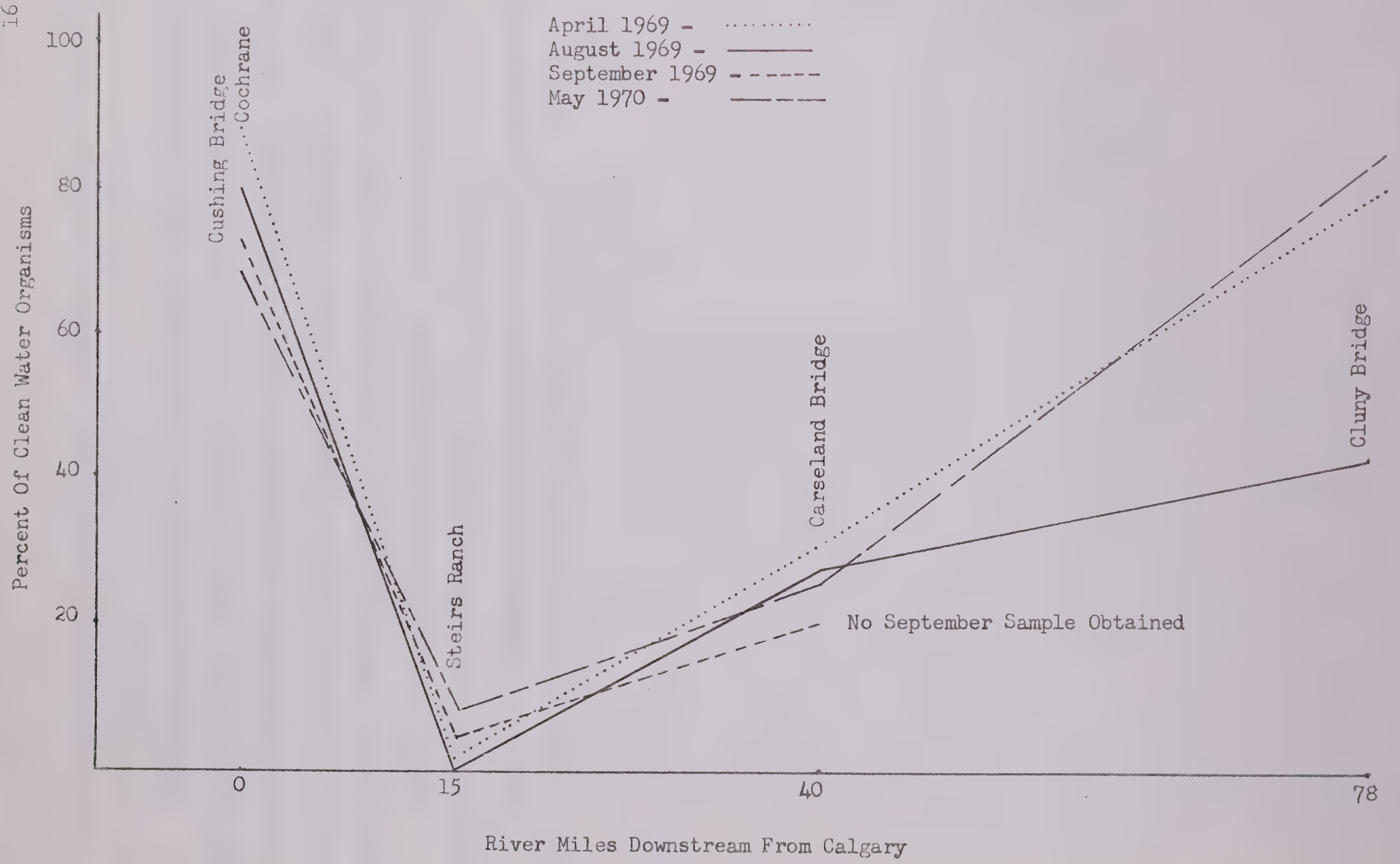
SITE #4, Cluny Bridge.

The mature ecosystem indicating total recovery is once again established at this site.

The Bow River results reflect a classic organic pollution picture (see the Discussion of Results section for definition). The site above Calgary represents the clean water zone, the mature ecosystem. This zone contains many types of organisms but relatively few organisms per type. It

Figure 4. Bow River Biological Pollution Survey

The percent of organisms indicative of clean water.



is a stable, protective ecosystem with the quality of organisms, including fish, being very high.

The zone immediately below, Site #2, is the degradation and active decomposition zone. Active decomposition occurs with a resultant increase in growth and production of organisms but at the loss of quality. The fish population reflects this change; many more suckers, and larger but poorer quality trout. Quality of organisms is sacrificed for quantity.

Site #3 is located in the recovery zone. The area is intermediate between a young and a mature ecosystem.

Site #4 is located in the complete recovery zone or the clean water zone. A mature ecosystem has once again been established.

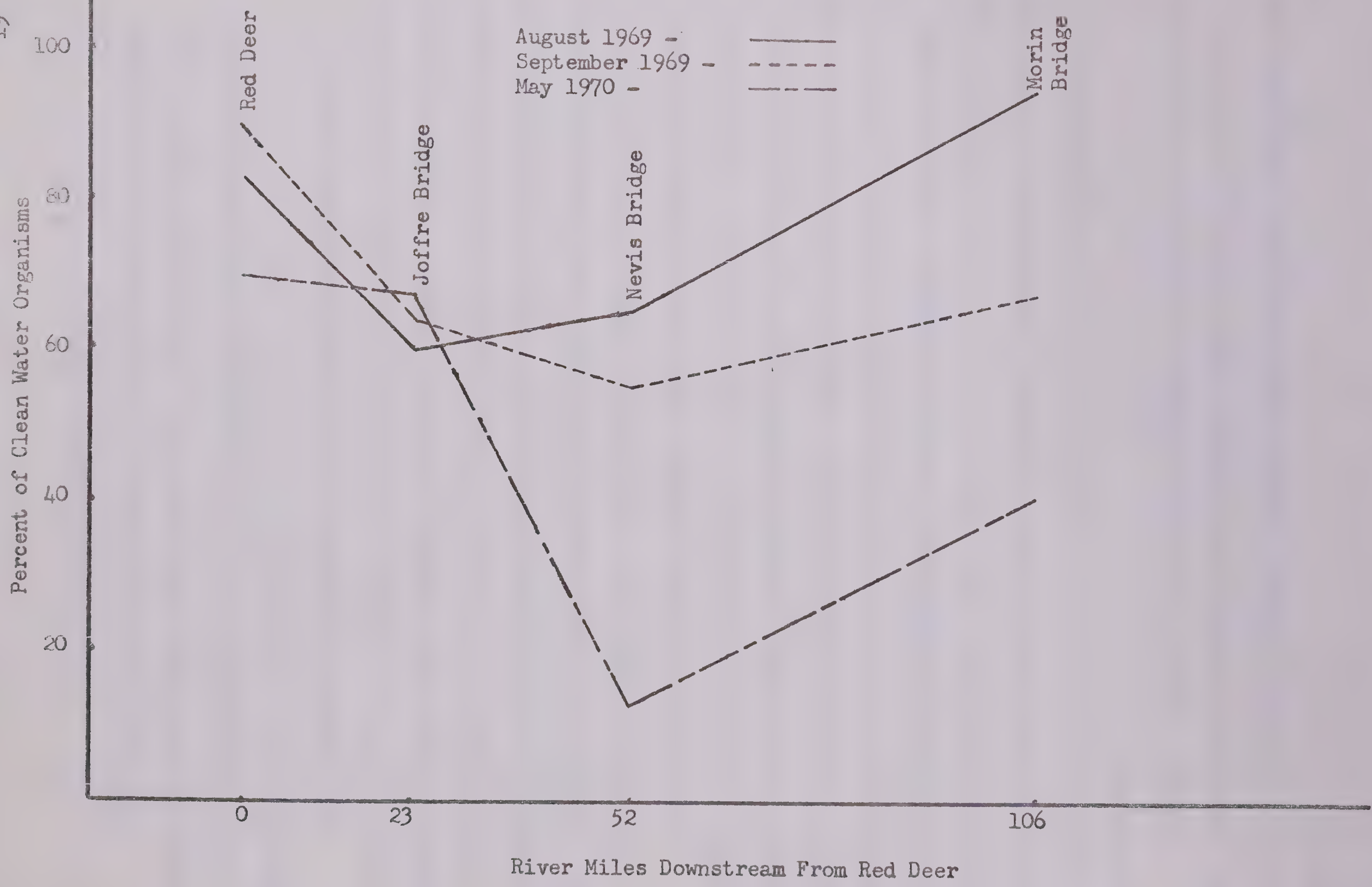
RED DEER RIVER

This report presents a summary of biological results obtained during the period August 1969 to May 1970.

The fall samples taken from the Red Deer River indicate a river suffering from a relatively mild case of organic pollution (Figure 5). The sample taken in the spring, however, reveals the results of a well documented case of oxygen deficiency during the winter period (see the Department of Public Health report). The sample obtained from the Nevis Bridge site may not actually indicate the worst conditions found in the river. This sample site in winter is not covered with ice. Reoxygenation may have occurred at or above this site. An additional sampling station should be located between the Joffre and Nevis sites.

Figure 5. Red Deer River Biological Pollution Survey

The percent of organisms indicative of clean water.



NORTH SASKATCHEWAN RIVER

This report presents a summary of the biological results obtained during the period August 1969 to May 1970. The biological condition of the North Saskatchewan River did not change very much during this period (Figure 6).

Above Edmonton the percent of clean water associated organisms indicates a mature ecosystem. A look at the total number of animals (not presented in this paper), however, indicated a sparsely inhabited ecosystem. The Beverly Bridge site appears to be suffering from the effects of organic pollution. One finds a total eradication of clean water organisms at this site. The habitat is now occupied by blood worms and sludge worms (Figure 7). This could be termed the degradation and active decomposition zone.

If the river were only suffering from organic pollution one would expect to find recovery occurring at the Vinca bridge site. The minimal recovery of clean water organisms combined with the decline in the total number of pollution-tolerant organisms (sludge worms and blood worms) would seem to indicate that the river is not only suffering organic pollution but is also suffering from additional poisonous pollution contacted somewhere between these two sites. The river does begin to recover at Site #4, Pakan Bridge. The spring sample, taken at Duvernay, (approximately 20 river miles further downstream) collaborates that the river is steadily recovering in this portion.

Complete recovery to a mature ecosystem is achieved at the Elk Point site. Additional sampling between Duvernay (90 river miles) and Elk Point (143 river miles) may indicate a complete recovery in less river miles than shown.

Figure 6. North Saskatchewan River Biological Pollution Survey

The percent of organisms indicative of clean water.

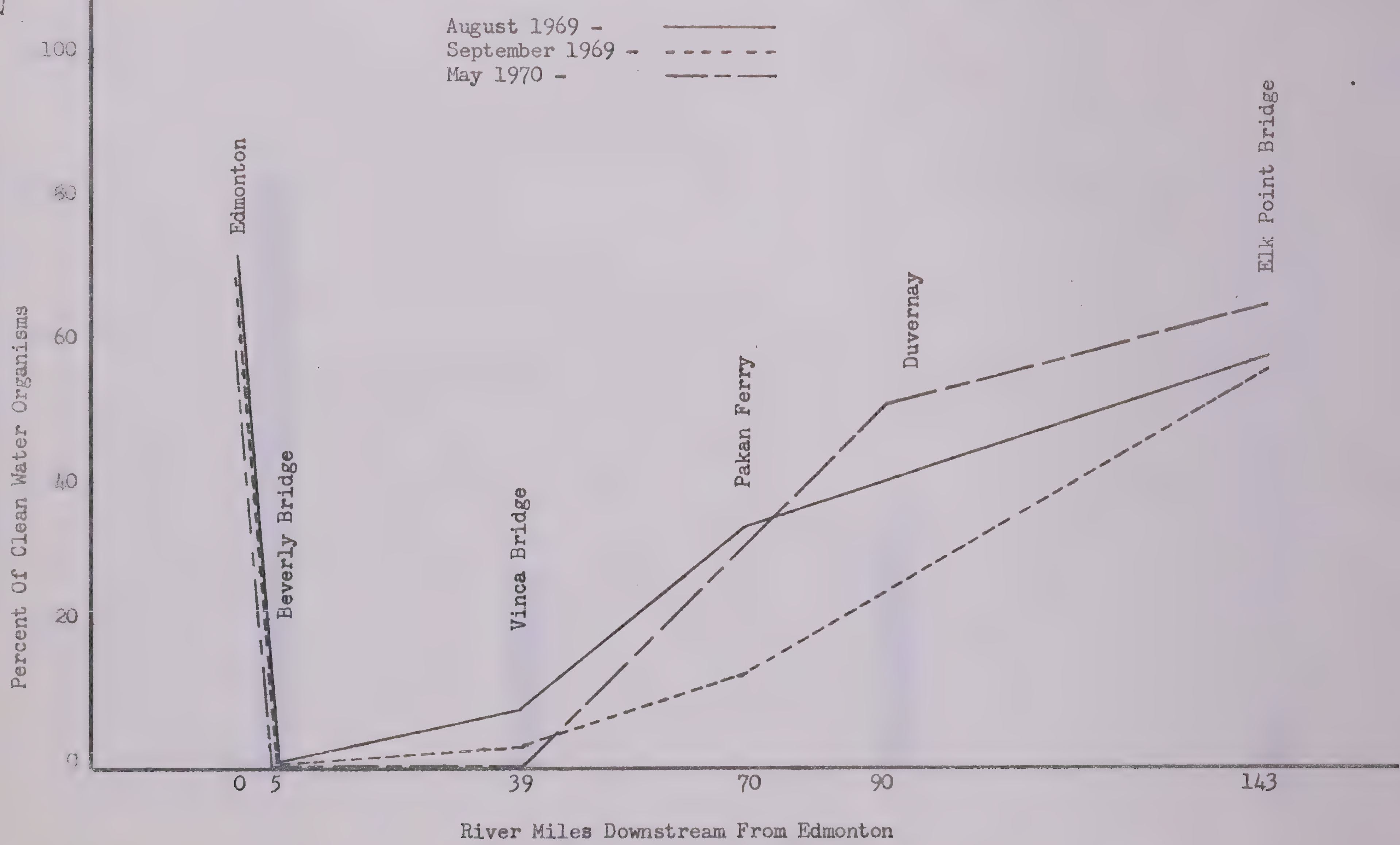
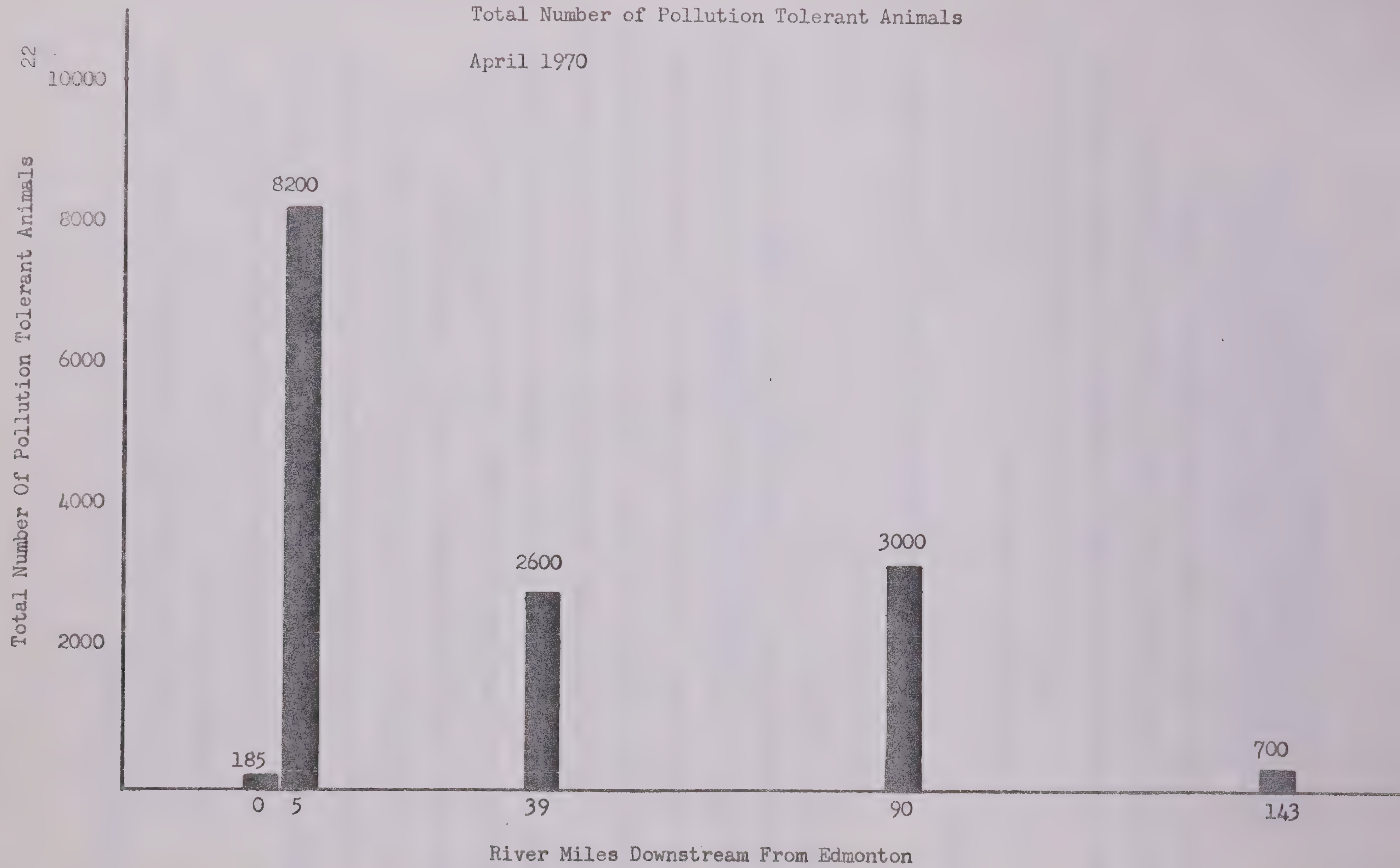


Figure 7. North Saskatchewan River Biological Pollution Survey

Total Number of Pollution Tolerant Animals

April 1970



DISCUSSION OF RESULTS

Some undefined terms were used in the presentation of the results.

1) Organic Pollution.

This extremely common form of pollution is due to the presence of proteins, fats, carbohydrates, and other organic substances and materials found in sewage and trade wastes. Most of these materials, with few exceptions, can be broken down by micro-organisms present in river water, and dissolved oxygen is used up in these reactions. If sufficient dissolved oxygen is present, aerobic bacteria break down the organic matter completely to directly harmless and odourless end products. Example: CO_2, H_2O, nitrates, sulphates, and phosphates. Some of these are the components of fertilizer, however, and so may cause secondary problems. If not enough oxygen is available, a different set of bacteria break down the material to differenct end products. Putrefaction then occurs with a resultant obnoxious smell. The idealized effect of organic pollution is presented in Figure 8.

2) Poisonous Pollution.

The material is poisonous, killing all organisms indiscriminately.

3) Young and Mature Ecosystems.

This can best be explained by quoting from a paper entitled "How to Think Ecologically" recently presented to the Calgary Chamber of Commerce Pollution Seminar by Dr. Everett B. Petersen, University of Calgary. This talk was illustrated with Figures 9, 10, and 11.

> "In the young phase of ecosystem development (Figures 9 and 10) there is a large excess of gross production of organic matter (income) over consumptive respiration of that organic matter (expenses) to yield a large net

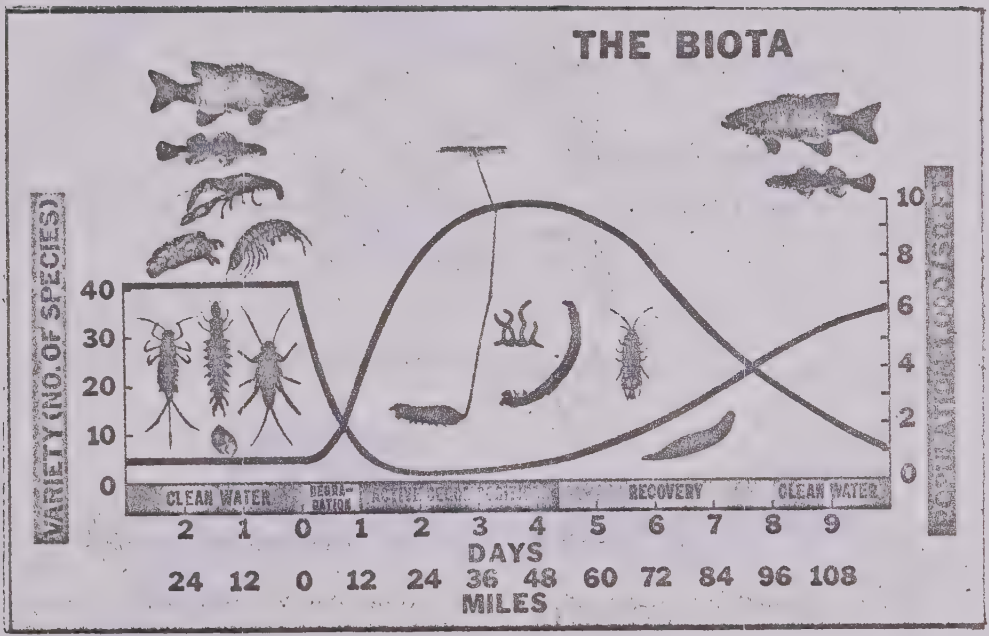


Figure 8. The (upper) curve shows the fluctuations in numbers of species: the (lower) the variations in numbers of each.

Taken from Stream Life and the Pollution Environment by A. F. Bartsch and W. M. Ingram.

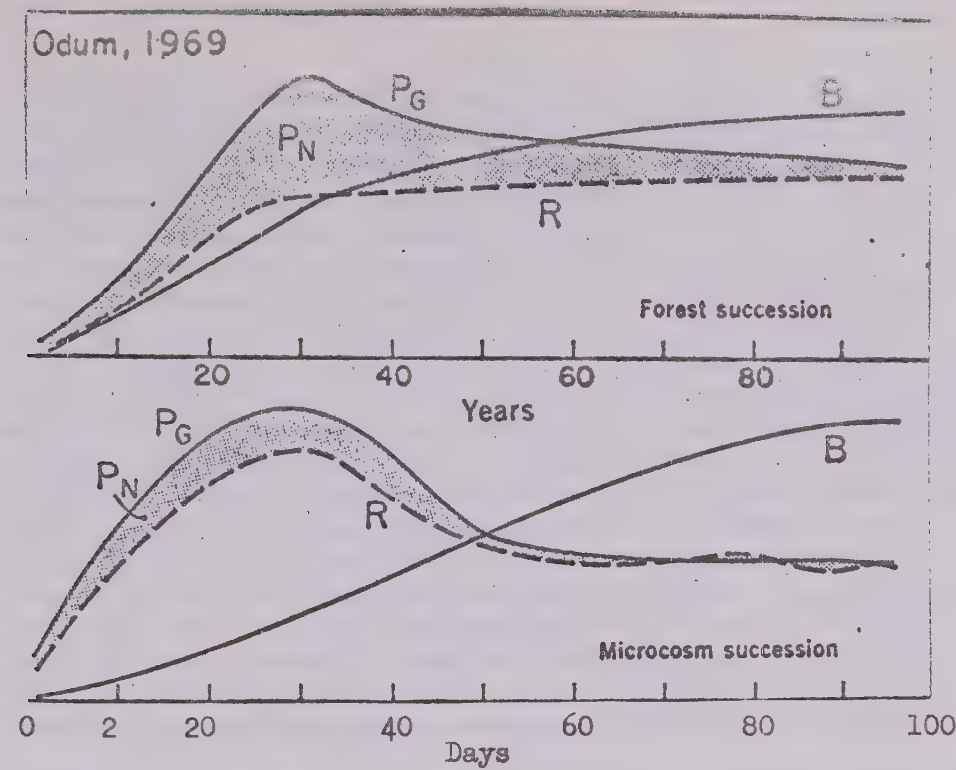


Figure 9.

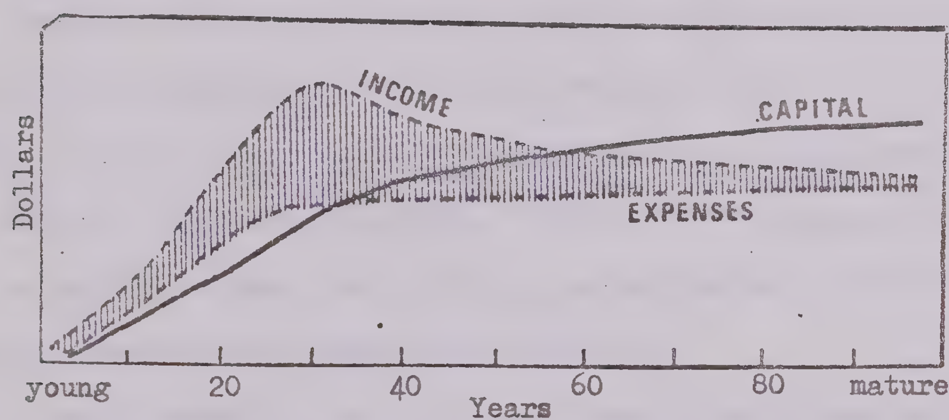


Figure 10.

YOUNG	MATURE
PRODUCTION	PROTECTION
GROWTH	STABILITY
QUANTITY	QUALITY

Figure 11.
Taken from How to Think Ecologically by E. B. Petersen.

> production available for harvest by man (profit) - and this is accomplished with relatively little biomass or standing crop (capital). In contrast, during the mature phase of ecosystem development, most or all of the organic matter produced (income) is consumed internally in the ecosystem by a complex food web (expenses) so that standing crop (capital) ceases to accumulate. In the mature phase where the large amount of standing crop remains constant there is no further net production (profit) because all energy is channelled into maintaining the large and complex standing crop. We may summarize these important functional features of young and mature systems in a simple table (Figure 11); young phases have high productivity, rapid growth rates, and large quantities of material available for harvest; mature phases have low productivity because all income goes to protection of the large and complex structure, they have high stability, and they are qualitatively rich because of the great species diversity, complex food webs and closed biogeochemical cycles. Thus, young phases represent PRODUCTION LANDSCAPE and mature phases represent PROTECTION LANDSCAPE."

But what have we really accomplished with the presentation of these results. The public wishes a simple answer to the question: "Are our rivers polluted or not?" As many by now realize, there is no absolute definition of pollution. The term depends upon one's own interpretation. As Dr. Petersen stated in his paper: "For many, the interpretation of what I have to say will depend upon whether I am categorized with those who would stop progress and technological activity."

> "I would advocate change and seek alternative approaches in technological activity whenever one or more of the following questions can be asked:
>
> (1) I question it when land and landscape components are physically disturbed in ways that are ecologically unwise and, therefore, in the long term economically unwise;
> (2) I wonder about the continued expansion of "productive landscape" until we know how far we can safely go in that trend;
> (3) I question the continued placement of wast in waste receptacles after those receptacles are full. Insofar as we view the air, water and soil as communal receptacles for unwanted materials, I seek alteration or elimination of those activities that concentrate wastes beyond the capacity of the receiving ecosystems

to absorb and renovate the discarded materials;
(4) I question technological ventures that produce, advertise and market products that are designed to be soon obsolescent and for which a public demand has to be created."

This report has completed the ecologist's task for 1969-1970. The next step must be completed by the environmental scientists; those who can tell us what is technically feasible. They in turn must receive advice from the economists, what is economically feasible. They in turn must receive advice from sociologists and others; they in turn from our politicians; and the politicians in turn must receive their mandate from the people.

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APPENDIX

SUMMARY OF RIVER SURVEY

OLDMAN AND SOUTH SASKATCHEWAN RIVERS

INTRODUCTION

The Oldman River, a major water course in the South Saskatchewan River Drainage Basin, originates in southwestern Alberta and northwestern Montana. Aesthetically, the upper reaches of its dendritic water courses have an excellent recreational potential. Physical and chemical alterations to the watersheds have been quite limited. Exceptions occur in the Crowsnest, Drywood, and Vicary watersheds. Alterations to these watersheds have reduced the productivity of their water courses and have damaged their aesthetic value.

Alterations have been made to the flow regimes of the upper Oldman River by the construction of irrigation storage reservoirs. The management of these reservoirs has, up to the present, proved detrimental to the recreational resources of the river system.

The lower Oldman River and the South Saskatchewan River from the confluence of the Bow and Oldman Rivers to the Saskatchewan border is not considered as a prime recreational area. However, the fishery potential could be as great or possibly exceed that of the headwater water courses from the standpoint of productivity. The present fishery is limited directly by domestic and industrial pollution, as well as physical alterations. Physical disturbance of the river bottom by gravel removal operations may have had detrimental effects upon the fishery.

In an attempt to outline water quality standards and effective pollution control, a river use survey on the Oldman and South Saskatchewan Rivers has been initiated by the Oldman River Pollution Control subcommittee. The survey is designed to gather data on the present and potential uses of the Oldman and South Saskatchewan Rivers with respect to domestic, industrial, recreational and agricultural users. The survey has divided the water courses in question into three areas: 1) headwaters and tributaries upstream from Lethbridge, 2) from Lethbridge to the junction of the Bow River, and 3) the South Saskatchewan River.

HEADWATERS AND TRIBUTARIES UPSTREAM FROM LETHBRIDGE

That portion of the Oldman River Drainage System upstream from the city of Lethbridge to the Alberta Forests Reserve boundary has received numerous man-made alterations which have reduced the productivity of the Oldman River and its tributaries. A review of a number of the irrigation storage reservoirs suggested that a great deal could be done to improve the sport fishery by modification of water discharges, providing consideration to all downstream water users (Haugen, 1968). In discussing the management of these reservoirs with agencies responsible, it was apparent that no use of these water bodies (such as recreational, domestic use, etc.) other than irrigation has, up to the present, been given serious consideration. For example, mean monthly discharges on the St. Mary's River below the St. Mary Reservoir were less than 30 c.f.s. for a 24 - month period (not consecutive) between September, 1962 and October, 1966.

Large scale alterations to the Oldman River Drainage within the green area have been limited to the Vicary Creek, Crowsnest River and Drywood Creek Drainage. For example, McGillivray Creek, tributary to the Crowsnest River, has received a high degree of chemical contamination from the mine industry (Haugen, 1968). Other water courses which are receiving similar deletarious effects are Glacier Creek, Crowsnest River, Gold Creek and Vicary Creek. Gas plants along the banks of the Drywood Creek have at times altered its water quality.

The Oldman River, together with its tributaries, has one of the better sport fishery capabilities in the province. Cutthroat, dolly varden, rainbow and eastern brook trout frequent the water courses of the Oldman River Drainage System upstream from the city of Lethbridge. Northern pike, mountain whitefish, goldeye, sauger and walleye are also found in that portion of the Oldman River above Lethbridge to the Alberta Forest Service boundary.

LETHBRIDGE TO THE JUNCTION OF THE BOW RIVER

That portion of the Oldman River from Lethbridge to the confluence of the Bow and Oldman Rivers has received a great deal of both physical and chemical alteration from domestic and industrial users (Kupchanko, 1967). Angler use of this portion of the Oldman River at present is considered as non-existent by local residents from Lethbridge to Taber. Fish populations within this area, however, do exist. In interviewing a number of the long-time local residents, it was learned that an excellent sport fishery was utilized in this portion of the river prior to its present condition and included walleye, northern pike, sauger, mountain whitefish, goldeye and lake sturgeon. All of these species are considered as excellent game fish and if proper controls were placed upon industrial and domestic wastes, the fishery could be re-established in the Oldman River between Lethbridge and the confluence of the Bow and Oldman Rivers.

SOUTH SASKATCHEWAN RIVER

The South Saskatchewan River from the confluence of the Bow and Oldman Rivers to the south Saskatchewan border receives slightly more angling pressure at present that the area between Lethbridge and the confluence of the Bow and Oldman Rivers. Here again, angling potential has been reduced by what is considered by local residents as pollution from upstream sources. The sport fishery in this portion of the river is potentially of great value to local residents and has in the past provided an excellent fishery for goldeye, sauger, northern pike, lake sturgeon and trophy walleye. According to many of the local residents, the trophy walleye fishery in this portion of the South Saskatchew River in years past could not be duplicated anywhere in the province. However, contamination from both industrial and domestic water users upstream has greatly reduced this potential.

SUMMARY

It is apparent that the Oldman and South Saskatchewan Rivers are greatly affected by pollution from both domestic and industrial users. The

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physical manipulation of discharges are also exerting a stress on the aquatic environment. These have combined to reduce the productivity of the water courses and the value of the sport fishery resource.

It is apparent from interviews with a number of industrial and domestic water users along the banks of the water courses involved, as well as with local residents, that little consideration has been given to the disposal of waste products.

In summing up the present status of the Oldman and South Sasktachewan Rivers, it is obvious that a great deal of work must be done to enforce pollution legislation, as the present status of these rivers, from the standpoint of contamination by both industrial and domestic users, is a disgrace to southern Alberta. Consideration must be given, therefore, to all those who use water for one purpose or another. A comprehensive plan must be set up and followed so that all water users will be given an equal opportunity to share in the benefits of good water use management. There is no doubt that from the standpoint of sport fishery and recreational use, the South Saskatchewan and Oldman River Drainage Systems have a great potential, much of which has been seriously reduced by the undesirable condition of the river downstream from the city of Lethbridge, on to the Saskatchewan border. The fishery (angler utilization) which did exist could be re-established, provided proper steps are taken to control the addition of domestic and industrial wastes into the water courses. Consideration must also be given to uses other than irrigation in the manipulation of the irrigation storage reservoirs.

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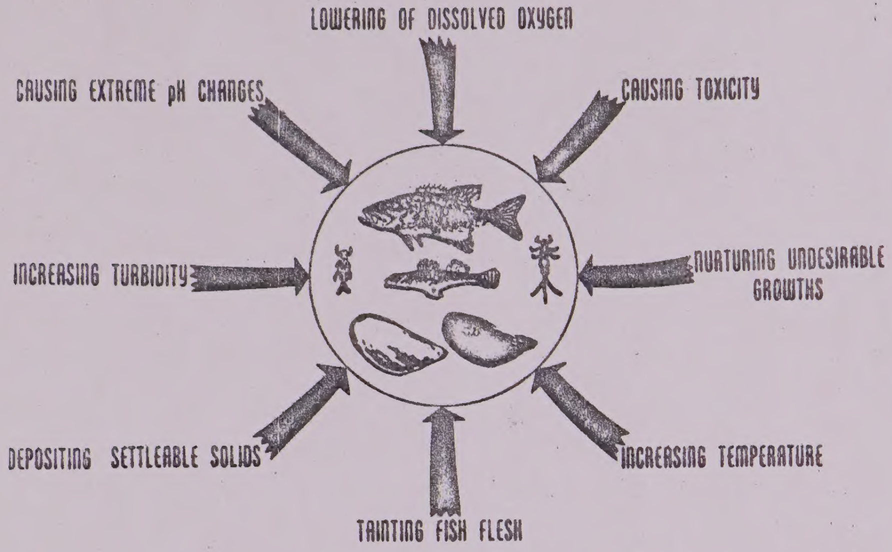
APPENDIX B



Ways in which pollution may affect aquatic life.

Environmental changes caused by industrial and municipal waste effluents can be detrimental to aquatic life in varying degrees. These include decreases in dissolved oxygen to harmful levels; increases in turbidity; formation of sludge deposits by settleable inert and decomposable solids; increased in chemicals to toxic levels; changes in pH toward extremes in acidity or alkalinity; increases in temperature; tainting of fish flesh; and production of nutrients resulting in undesirable aquatic growths.

Taken from Biological Associated Problems in Freshwater Environments: Their Identification, Investigation and Control by K. M. Mackenthun and W. M. Ingram.